

(12) UK Patent Application (19) GB (11) 2 332 630 (13) A

(43) Date of A Publication 30.06.1999

(21) Application No 9727221.5

(22) Date of Filing 23.12.1997

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(51) INT CL⁶
A63B 69/00 63/00

(52) UK CL (Edition Q)
A6D DPB DPX

(56) Documents Cited
GB 2270004 A GB 2232898 A US 4974833 A

(58) Field of Search
UK CL (Edition P) A6D DPB DPX D13A
INT CL⁶ A63B 63/00 69/00 69/34
Online: WPI

(54) Abstract Title
Apparatus for improving reflexes and reactions

(57) The apparatus includes a plurality of pads 3 representing balls each having an associated light 4 which is capable of being activated in a random or preset sequence by a control unit. Each pad 3 has a switch (16, Fig 3) which is operable to deactivate the light 4 associated with that pad 3 when it is contacted by a user. The control unit also detects when a light 4 has been deactivated and activates the next light 4 in the sequence. The pads 3 also have spring means (8, Figs 3-5) to push them back into shape after being compressed. The apparatus is primarily for use by soccer players as a training aid.

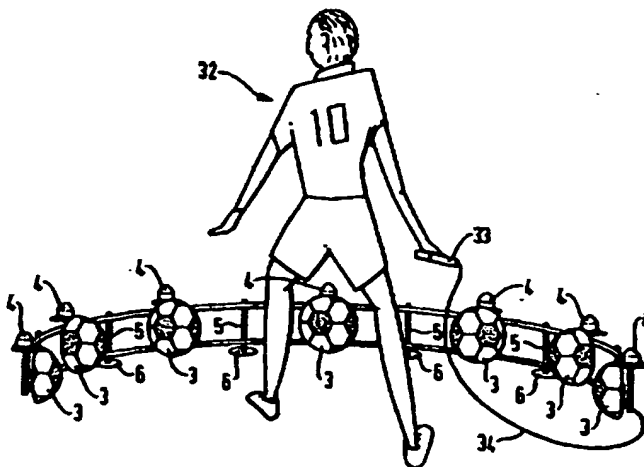


FIG. 14

GB 2 332 630 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

APPARATUS FOR IMPROVING THE REFLEXES AND REACTIONS OF
SPORTSMEN/WOMEN.

The present invention relates to an apparatus for
5 improving the reflexes and reactions of sportsmen/women.
In particular, it relates to a device for improving and
assessing the skill and reactions of soccer players.

Many sports require the participant to perform a number
10 of different movements quickly and in rapid succession.
In soccer, for example, passing, tackling and winning of
the ball requires a substantial degree of skill and quick
thinking if the participant is to successfully play the
game. Usually, the proficiency of the participant in
15 carrying out the type of movements which frequently occur
when playing soccer depends upon their coordination,
reflexes, balance and speed and it takes a considerable
length of time and experience to learn these skills
before a sufficient level of competence is reached.

20

The primary form of training involves actually playing
soccer as often as possible as no other type of training
is sufficiently realistic or directed specifically at
developing the necessary skills. However, the
25 opportunity to play on a regular basis does not always
arise and so other forms of general fitness training must
be undertaken instead. Although this results in an
improvement in overall fitness of the player, it

generally does not develop the essential skills which a soccer player must possess if they are to quickly improve their technique and abilities.

5 Furthermore, it is impossible for a soccer player to accurately monitor and assess their performance over a period of time and thereby enable them to pinpoint their strengths and weaknesses to give them an indication of areas in which improvement and further training is
10 required to fully develop their skills in all areas of the game.

It is an object of the present invention to overcome or substantially alleviate the problems mentioned above.

15

According to the present invention, there is provided an apparatus for improving the reflexes and reactions of sportsmen/women including a plurality of contact members each having a visual indicator associated therewith
20 capable of being activated in accordance with a random or preset sequence, switch means associated with each contact member operable to deactivate said associated visual indicator when contacted by a user, and control means for detecting when a visual indicator has been
25 deactivated and for activating the next visual indicator in the sequence.

Preferably, each contact member comprises a compressible

member which activates the switch means when compressed
on being contacted by the user.

Each compressible member also preferably includes spring
5 means to push the compressible member back into shape
after being compressed.

In a preferred embodiment, the switch means comprises a
pressure valve activated by air which is expelled from
10 the compressible member when compressed.

In an alternative embodiment, each contact member
comprises a member deflectable against a bias to activate
the switch means.
15

Conveniently, the switch means is an electrical contact
switch activated on contact by the contact member when
deflected against the bias.

20 Each visual indicator is conveniently mounted to a
backplate of the contact member so as to be visible to a
user when using the apparatus.

Preferably, each visual indicator is a lamp,
25 extinguishable on activation of the switch means.

In another alternative embodiment, each contact member is
a shell formed from a translucent material and a lamp is

mounted within each shell so as to be visible through the shell when the lamp is illuminated.

Preferably, each contact member, associated visual
5 indicator and associated switch means together comprise a single unit.

In a preferred embodiment, an array of contact members are arranged facing the user, preferably in an arcuate
10 configuration.

The contact members may also be arranged around the user in several arcs positioned one above the other or, alternatively arranged in a single plane.

15

Preferably, the contact members are mounted on a frame and in the preferred embodiment, the frame includes attachment means for fixing to a wall or the ground.

20 In one embodiment, the frame may conveniently be made in a modular construction.

Embodiments of the present invention will now be described, by way of example only, with reference to the
25 accompanying drawings, in which:

FIGURE 1 illustrates a front view of a preferred embodiment of the invention;

- FIGURE 2 illustrates a top plan view of the preferred embodiment illustrated in Figure 1;
- FIGURE 3 illustrates a front and side elevation of a ball pad according to a preferred embodiment;
- 5 FIGURE 4 illustrates a front and side elevation of a first alternative ball pad of a preferred embodiment;
- FIGURE 5 illustrates a front and side elevation of a second alternative ball pad of a preferred embodiment;
- FIGURE 6 illustrates an embodiment of the preferred frame for use outdoors and on soft ground;
- 10 FIGURE 7 illustrates an embodiment of an alternative frame for use indoors;
- FIGURES 7A & 7B illustrate in greater detail how the frame of Figure 7 is attached to the floor for use indoors;
- 15 FIGURE 8 illustrates an embodiment of another configuration of frame with an alternative fixing arrangement for use indoors;
- FIGURES 9 to 9B illustrate different configurations of spar bases for additional grip outdoors, on carpeted floors and on smooth floors respectively;
- 20 FIGURES 10 & 10A illustrate front and side views respectively of an alternative frame for attaching to a wall surface and having a number of ball pads disposed at different heights;
- 25 FIGURE 11 illustrates an alternative frame similar to the frame shown in Figures 1 and 2 but of larger size and having a number of ball pads arranged at different

heights;

FIGURE 12 illustrates another alternative frame of a modular construction;

FIGURE 13 illustrates an exploded fragmentary view of the
5 frame illustrated in Figure 12.

FIGURE 14 illustrates the position in which a person should stand whilst using any of the preferred embodiments.

FIGURES 15-26 illustrate various additional modular frame
10 configurations.

Referring now to Figures 1 and 2, a reflex and reaction training system for soccer players 1 is shown and comprises a tubular frame 2 having seven mutually spaced
15 contact members in the form of ball pads 3 mounted thereon and a visual indicator in the form of a light 4 protruding upwardly from the rear of each ball pad 3.

The tubular frame 2 comprises a pair of hemispherical
20 spaced and horizontally oriented frame members 4a attached to six support legs 5 located at the mid point between each pair of ball pads 3. The legs 5 support the frame members 4 above the ground and the base of each leg includes a circular foot 6 to spread the load more evenly
25 over the surface.

The frame 2 forms the overall structure of the preferred embodiments and is manufactured from any suitable

material which has sufficient strength and flexibility to withstand the shock to which it will be subjected to when the ball pads 3 are kicked but which is light enough to be easily portable.

5

A preferred form of ball pad 3 will now be described with reference to Figure 3. Each pad 3 comprises a hemispherical outer shell 7 of a size corresponding to that of a typical football and is made from tough
10 industrial rubber or a similar durable material capable of absorbing high impact kicks. The surface of the outer shell 7 has an imprint commonly found on footballs to provide an enhanced visual appearance and add a degree of realism. A coil spring 8 is attached to and extends
15 between the interior of the shell 7 and a backplate 9 which includes four clips 10 on its rear surface to enable the ball pad 3 to be releasably mounted to the tubular frame 2, two clips 10 being attached to each of the frame members 4 to firmly retain the ball pad 3 in
20 position.

The indicator light 4 is attached to the backplate 9 and each light includes a pressure valve 16 extending from the interior of the shell 7 for controlling the operation
25 of the indicator light 4, as will be explained in more detail below.

In a first alternative ball pad, illustrated in Figure 4,

the hemispherical shell 7 has a rear cover 12 made from an electrically conductive material which locates in a groove 13 which runs along the inside edge of the hemispherical shell 7. In this embodiment, the spring 8 extends between the rear of the cover 12 and the backplate 9 and a switch unit 14, having an electrical contact point 15 on its outer surface facing the cover 12 is mounted on the backplate 9 within the spring 8. The rear of the backplate 9 is provided with four spring clips 10 to enable the ball pad 3 to be releasably attached to the frame 2 as in the previous embodiment. In an unillustrated modification of this alternative embodiment, a spring may be located within the shell 7 to absorb some of the impact when kicked and to ensure that it maintains its shape.

In a second alternative ball pad embodiment, illustrated in Figure 5, the outer shell is not hemispherical but has a much flatter shape. This embodiment is very similar to the embodiment previously described with reference to Figure 4 although the electrical contact 15 on the switch unit 14 protrudes therefrom towards the rear cover 12.

In both the first and second alternative ball pad embodiments, it will be appreciated that a pressure valve for controlling operation of the indicator light 4 is not required. Instead, contact between the electrically conductive cover 12 and the electrical contact on the

switch block 14 causes deactivation of the light 4, as will be explained in more detail hereafter.

In the ball pad embodiment of Figure 5, the indicator
5 light 4 has a smaller size than in the two previous embodiments and is mounted on the edge of the backplate 9.

In an additional but unillustrated embodiment, each of
10 the ball pads 3 are made from a translucent material and a light 4 is mounted within each. When the light 4 is illuminated, it can be seen through the ball pad 3.

Figures 6 to 9B illustrate different frame configurations
15 depending on where the apparatus is to be used. It will be appreciated that in any situation, the frame 2 must be firmly secured to prevent it from moving when the ball pads 3 are repeatedly kicked.

20 Figure 6 illustrates how the frame 2 may be secured when the apparatus is to be used outside and on soft ground such as grass. In this configuration, the tubular frame 2 is pinned to the ground using pins 17 which have a smaller diameter than the interior diameter of the
25 tubular support legs 5 and are longer so that they can slide through the legs 5 into the ground beneath the frame 2. It may be necessary to drive the pins 17 into the ground using a hammer until the head 18 of each pin

17 is in contact with the top of each leg 5 to ensure that the frame 2 is properly secured.

Reference will now be made to Figures 7 to 7B to explain how the frame 2 is preferably secured when the apparatus is to be used indoors in, for example, a gym or garage, or outdoors on hard ground. In this embodiment, seven holes corresponding to the positions of the legs 5 are pre-drilled in the floor surface 20 and a collar 18 is fitted and permanently retained in each. Each collar 18 has a tubular portion 19 which extends downwardly in the hole and a rim 19a which surrounds the tubular portion 19 and rests on the floor surface 20.

When the apparatus is to be used, a rod 21 is inserted into the tubular portion 19 of each collar 18 (as shown in Figure 7B) so that it protrudes upwardly from the floor surface 20 and is releasably retained by the collar 19. When a rod 21 has been inserted into each of the seven collars 18, the frame 2 is slid over the rods 21 so that each rod 21 is received within a tubular leg 5 (as illustrated in Figure 7A).

Figures 9 to 9B illustrate three different configurations of feet 6 which are threaded onto the tubular legs 5 and provide additional grip on various surfaces. Figure 9 shows a foot 6 with large serrated teeth 22 on its underside for providing additional grip when the

apparatus is used on a soft outdoor surface such as grass. Figure 9A illustrates the type of foot 6 which is suitable for use on carpeted floors and has smaller serrations 23 on its underside. Figure 9B illustrates a
5 foot 6 having a layer 24 of non-slip material such as rubber affixed to its underside to provide additional grip on smooth floors and to prevent damage thereto.

The frame 2 illustrated in Figure 8 is also for use
10 indoors or in any situation in which it is not possible or feasible to secure the frame 2 to the floor or ground. In this configuration, the frame 2 is positioned in front of a wall 26 and a pair of wall tie bars 27 extend from two of the legs 5 and are fixed to the wall 26. The wall
15 tie bars 27 include wall plates 28 which spread the load over a greater area of the wall 26 and enable the wall tie bars 27 to be firmly attached thereto. It will also be appreciated that the apparatus can be positioned in a corner between two walls in order to make the best use of
20 any space available.

Figures 10 and 11 illustrate other embodiments for use by those who already have a considerable amount of experience playing soccer but are seeking to further
25 improve their skills or additionally supplement their training schedule. Figure 10 shows a frame 2 which is flat rather than hemispherical to enable it to be attached flat against a wall or supported on support bars

30. The frame 2 includes six horizontal cross-members 31 to which are attached eleven ball pads 3 at three different heights.

5 The frame 2 illustrated in Figure 11 retains the hemispherical shape but additionally includes a further two horizontal frame members 4 to increase the height of the frame 2 and enable an additional nine ball pads 3 to be attached thereto. This embodiment of frame may be
10 attached to the ground using any of the configurations described above.

Reference will now be made to the alternative frame illustrated in Figures 12 and 13. In this embodiment, the
15 frame 2 is made up of a number of separate panels 40 which lock together. As each panel 40 can pivot relative to its adjacent panel to which it is attached, the completed frame can be arranged in any preferred configuration such as in an arcuate form as illustrated
20 in Figure 12.

As can be seen in more detail in Figure 13, each panel 40 is attached to an adjacent panel 40 by passing a leg 5 through outer hinge members 41 formed on the edge of one
25 panel 40 and through inner hinge members 42 formed on the edge of an adjacent panel 40. A pin 17 can then be inserted through each leg 5 and into the ground beneath the modular frame 2 to secure it in position, as

described with reference to the embodiment illustrated in Figure 6, although other forms securing the frame 2 may alternatively be employed.

5 Figure 12 is illustrated with the first alternative ball pads 3, as shown in Figure 4, fitted to the modular frame 2. It will be appreciated that either of the other alternative ball pads 3 may also be used with the modular frame 2.

10

Figure 14 shows the position in which a player 32 should stand when using any of the above described embodiments. As shown in Figure 14, the player holds a control unit 33 which allows him to control the operation of the
15 apparatus and also gives him an indication of his score. A lead 34 extends from the control unit 33 to a system box (not shown) which houses the electronics required to control various programs described in more detail below and provides a link between the control unit 33 and the
20 ball pads 3 to which power is supplied via a mains supply or battery pack.

The system box may additionally house a sound module capable of generating an audible tone whenever a ball pad
25 3 has been successfully struck by the player.

The apparatus is controlled by one or more computer programs which in the preferred embodiment include at

least one program which enables the user to monitor his or her performance at different levels of difficulty by giving the user a fixed scale against which he or she can compete, and a second program which enables the user to
5 assess the speed of his or her reactions.

To monitor a performance level, the appropriate computer program can be selected by controlling buttons on the control unit 33. The desired duration of the program is
10 also input together with the required skill level.

Each skill level varies the number of ball pads 3 which must be struck in a given length of time, the higher the skill level, the more ball pads 3 must be struck to
15 obtain a high score. For example, an amateur would select an easy skill level in which 60 ball pads 3 must be kicked in one minute, whereas a very experienced player would select a much higher skill level, for example, one in which 120 ball pads must be kicked in one minute.

20

Operation and use of the preferred embodiments will now be described in more detail. When the user wishes to commence using the apparatus, he/she stands facing the ball pads 3 such as illustrated in Figure 14. The
25 program commences when the user presses a button on the hand held control unit 33 and a light 4 mounted behind one of the ball pads 3 illuminates and should be kicked as quickly as possible to activate the switch means to

extinguish the light 4 and cause a signal to be sent to the systems box which records a successful hit. If the player is too slow, the light is extinguished before being hit and another light is activated without any
5 score being obtained.

When the shell 7 of a ball pad 3 is kicked with sufficient force, it squashes causing the air within it to be expelled through the pressure valve 16 to
10 extinguish the light 4. As the coil spring 8 pushes the shell 7 back into its original shape, the pressure valve 16 releases and returns to its starting position ready for the next kick following a further activation of the light 4. When a light 4 is extinguished following a
15 successful kick, a different light 4 is activated under the control of the computer program to indicate that its associated ball pad 3 should be kicked next.

In the first and second alternative embodiments of ball
20 pads 3 illustrated in Figures 4 and 5, the shell does not need to be as flexible as deactivation of the light 4 is not controlled by a pressure switch 16 as in the embodiment of Figure 3. Instead, the whole shell 7 moves towards the backplate 9 when the ball pad 3 is kicked
25 against the bias of the spring 8. If the ball pad 3 has been kicked hard enough, the cover 12 comes into contact with the electrical contact point 15 which causes the light 4 to be extinguished.

Illumination of each light 4 may occur either in a random pattern or in accordance with a preselected sequence. A player can also optionally select a 'ball bias', in which the lights 4 associated with the ball pads 3 on one side
5 are activated more frequently than those to the players other side to enable the player to improve his weaker foot.

When the player wishes to measure the speed of his
10 reactions, an alternative program can be selected in which each light 4 remains on until its associated ball pad 3 has been kicked successfully to extinguish the light 4. The score depends upon the speed in which the player reacts and the time taken to extinguish the light
15 4 will be registered in the systems box via a signal sent by the pressure valve when the ball pad 3 is kicked. The score will be assessed according to how many activated ball pads 3 a player has kicked during the selected duration- the quicker the player kicks the ball pad, the
20 higher his score.

At the end of the duration of any program, the score will be displayed on a display panel on the control unit as a percentage ratio, ie, the number of successful kicks
25 compared to the number signalled. In addition, the player will be provided with a percentage ratio to give him an indication of any bias in his performance with either foot.

As will be appreciated from the detailed description of the preferred embodiments, the present invention provides a versatile training device for keen sportsmen/women who wish to improve their timing and reflexes, and is
5 designed especially, but not exclusively, for those who play soccer.

Various additional alternative frame configurations are illustrated in Figures 15 to 26. Top plan views of four
10 different modular frame sections are shown in Figure 15. Figure 16 illustrates a front view of an assembled modular frame section and Figure 17 illustrates an exploded unassembled view of the frame shown in Figure 16. Figures 18 to 26 illustrate how each modular frame
15 section may be coupled to an adjacent section and the configurations shown are generally self-explanatory to a skilled person.

It will be appreciated that the above embodiments are
20 described by way of example only and it is pointed out that many modifications and alterations are possible that fall within the scope of the following claims.

CLAIMS

1. Apparatus for improving the reflexes and reactions of sportsmen/women including a plurality of contact
5 members each having a visual indicator associated therewith capable of being activated in accordance with a random or preset sequence, switch means associated with each contact member operable to deactivate said associated visual indicator when contacted by a user and
10 control means for detecting when a visual indicator has been deactivated and for activating the next visual indicator in the sequence.

2. Apparatus according to claim 1, wherein each contact
15 member comprises a compressible member which activates the switch means when compressed on being contacted by the user.

3. Apparatus according to claim 2, wherein each
20 compressible member includes spring means to push the compressible member back into shape after being compressed.

4. Apparatus according to claim 2 or 3, wherein the
25 switch means comprises a pressure valve activated by air which is expelled from the compressible member when compressed.

5. Apparatus according to claim 1, wherein each contact member comprises a member deflectable against a bias to activate the switch means.
- 5 6. Apparatus according to claim 5, wherein the switch means is an electrical contact switch activated on contact by the contact member when deflected against the bias.
- 10 9. Apparatus according to claim 7, wherein each visual indicator is mounted to a backplate of the contact member so as to be visible to a user when using the apparatus.
- 15 10. Apparatus according to any preceding claim, wherein each visual indicator is a lamp, extinguishable on activation of the switch means.
- 20 11. Apparatus according to claim 10, wherein each contact member is a shell formed from a translucent material and a lamp is mounted within each shell so as to be visible through the shell when the lamp is illuminated.
- 25 12. Apparatus according to any preceding claim, wherein each contact member, associated visual indicator and associated switch means together comprise a single unit.
13. Apparatus according to any preceding claim, wherein

an array of contact members are arranged facing the user.

14. Apparatus according to claim 13, wherein the contact members are arranged around the user in an arc.

5

15. Apparatus according to claim 14, wherein the contact members are arranged around the user in several arcs positioned one above the other.

10 16. Apparatus according to claim 13, wherein the contact members are arranged in a single plane.

17. Apparatus according to any preceding claim, wherein the contact members are mounted on a frame.

15

18. Apparatus according to claim 17, wherein the frame includes attachment means for fixing to a wall or the ground.

20 19. Apparatus according to claim 17 or 18, wherein the frame is of modular construction.

20. Apparatus according to any preceding claim, wherein control of the apparatus is carried out by a computer
25 processing unit programmed by the user on a hand held control panel.

21. Apparatus substantially as hereinbefore described

- 21 -

with reference to the accompanying drawings.

Amendments to the claims have been filed as follows

CLAIMS:

1. A soccer training apparatus including a plurality of contact members arranged, in an operable configuration,
5 to at least partially surround a user, each contact member having a visual indicator associated therewith capable of being activated by the user in accordance with a random or preset sequence, switch means associated with each contact member operable to deactivate said
10 associated visual indicator when a contact member is kicked by the user and control means for detecting when a visual indicator has been deactivated and for activating the next visual indicator in the sequence.
- 15 2. Apparatus according to claim 1, wherein each contact member comprises a compressible member which activates the switch means when compressed on being contacted by the user.
- 20 3. Apparatus according to claim 2, wherein each compressible member includes spring means to push the compressible member back into shape after being compressed.
- 25 4. Apparatus according to claim 2 or 3, wherein the switch means comprises a pressure valve activated by air which is expelled from the compressible member when compressed.

5. Apparatus according to claim 1, wherein each contact member comprises a member deflectable against a bias to activate the switch means.
- 5 6. Apparatus according to claim 5, wherein the switch means is an electrical contact switch activated on contact by the contact member when deflected against the bias.
- 10 7. Apparatus according to any preceding claim, wherein each visual indicator is mounted to a backplate of the contact member so as to be visible to a user when using the apparatus.
- 15 8. Apparatus according to any preceding claim, wherein each visual indicator is a lamp, extinguishable on activation of the switch means.
9. Apparatus according to claim 8, wherein each contact member is a shell formed from a translucent material and
20 a lamp is mounted within each shell so as to be visible through the shell when the lamp is illuminated.
10. Apparatus according to any preceding claim, wherein
25 each contact member, associated visual indicator and associated switch means together comprise a single unit.
11. Apparatus according to any preceding claim, wherein

an array of contact members are arranged facing the user.

12. Apparatus according to claim 11, wherein the contact members are arranged to at least partially surround the
5 user in an arcuate configuration.

13. Apparatus according to claim 12, wherein the contact members are arranged around the user in several arcs positioned one above the other.

10

14. Apparatus according to any preceding claim, wherein the contact members are mounted on a frame.

15. Apparatus according to claim 14, wherein the frame
15 includes attachment means for fixing to a wall or the ground.

16. Apparatus according to claim 14 or 15, wherein the frame is of modular construction.

20

17. Apparatus according to any preceding claim, wherein control of the apparatus is carried out by a computer processing unit programmed by the user on a hand held control panel.

25

18. Apparatus substantially as hereinbefore described with reference to the accompanying drawings.



Application No: GB 9727221.5
Claims searched: 1-21

Examiner: Kalim Yasseen
Date of search: 24 March 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.P): A6D (DPB, DPX, D13A)

Int CI (Ed.6): A63B 63/00, 69/00, 69/34

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 2 270 004 A (NELSON) see whole document especially figures 3 & 4.	1, 2, 9, 10, 12, 13, 16, 20
X	GB 2 232 898 A (NELSON) see whole document especially page 9 et al, page 26 lines 23-28, figures 1 & 4D	1, 2, 5, 6, 9-13, 16-20
X	US 4 974 833 A (HARTMAN) see whole document especially column 4 lines 1-6 & claim 1	1, 2

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

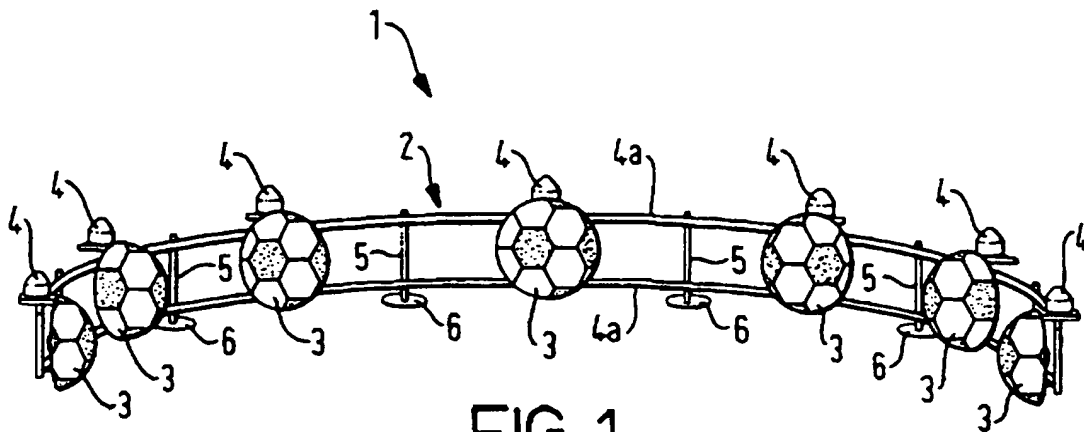


FIG. 1

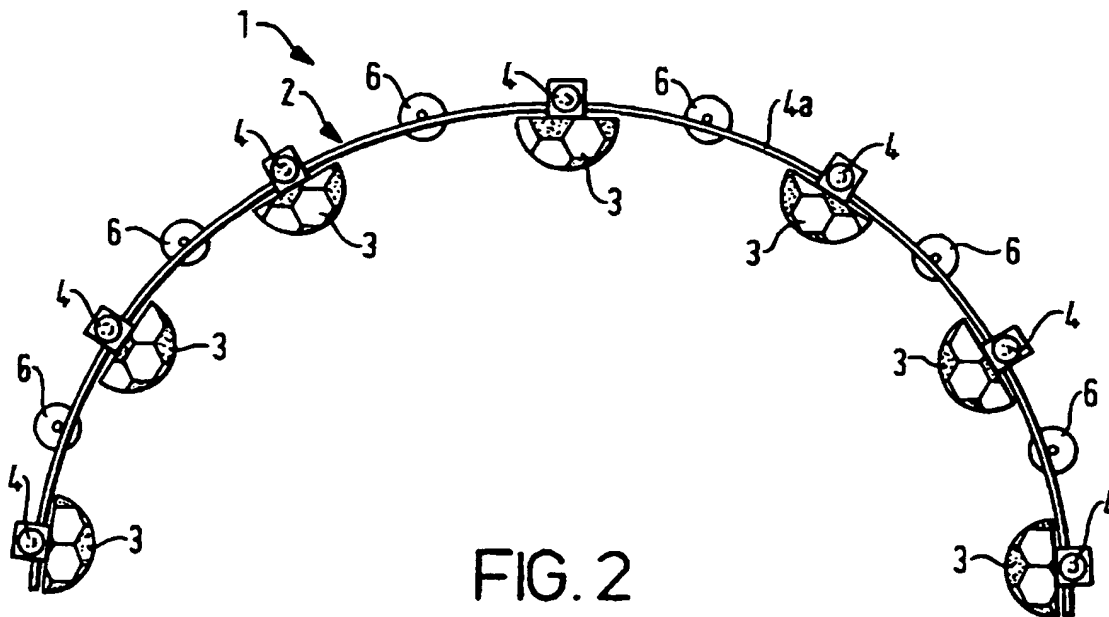


FIG. 2

FIG. 3

2/12

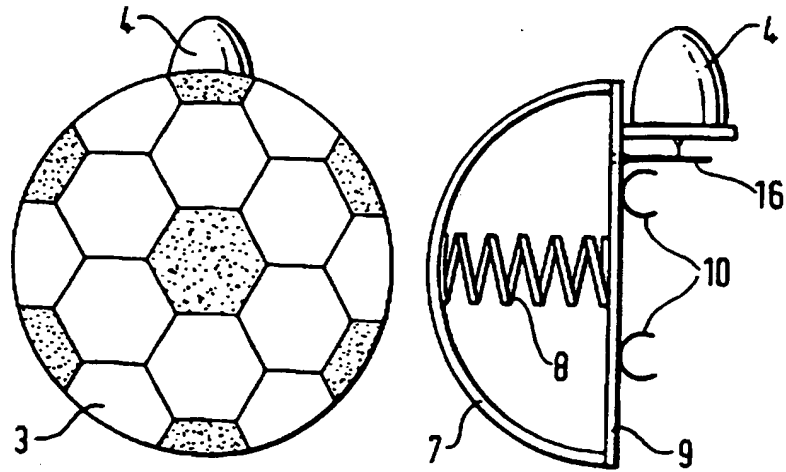


FIG. 4

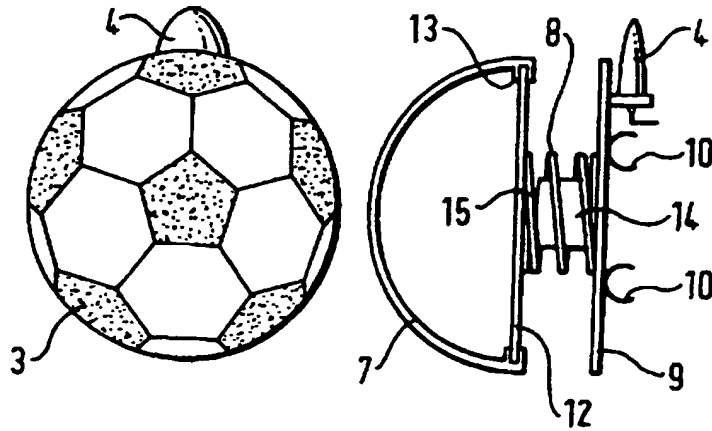
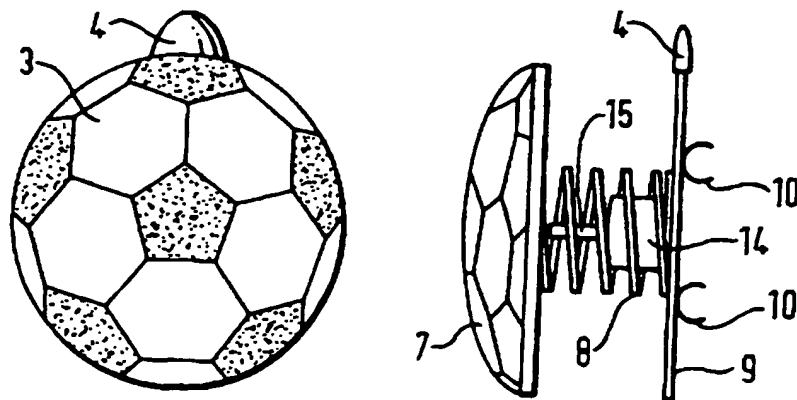


FIG. 5



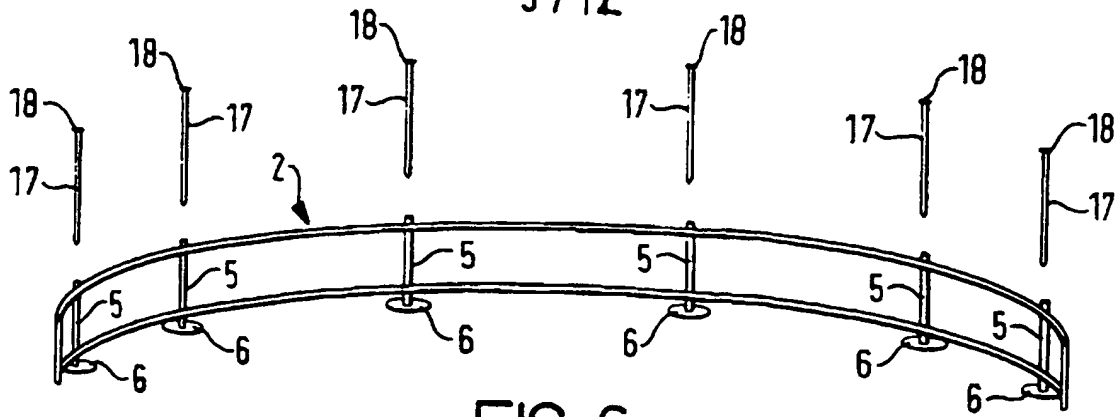


FIG. 6

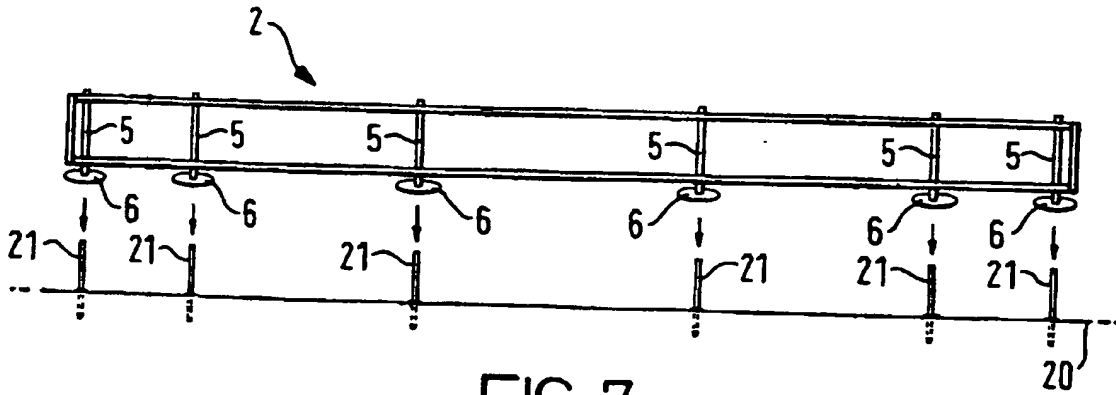


FIG. 7

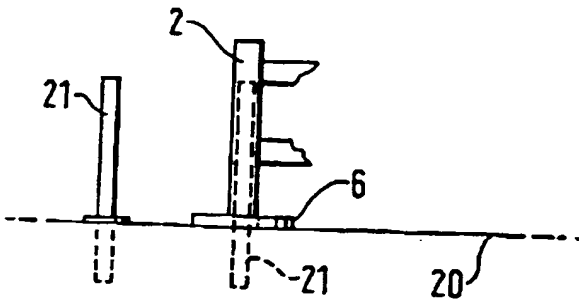


FIG. 7A

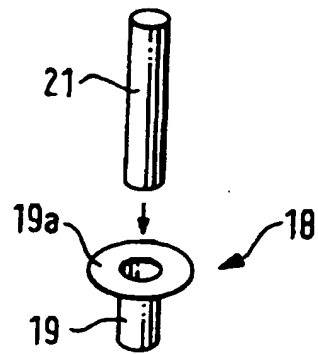


FIG. 7B

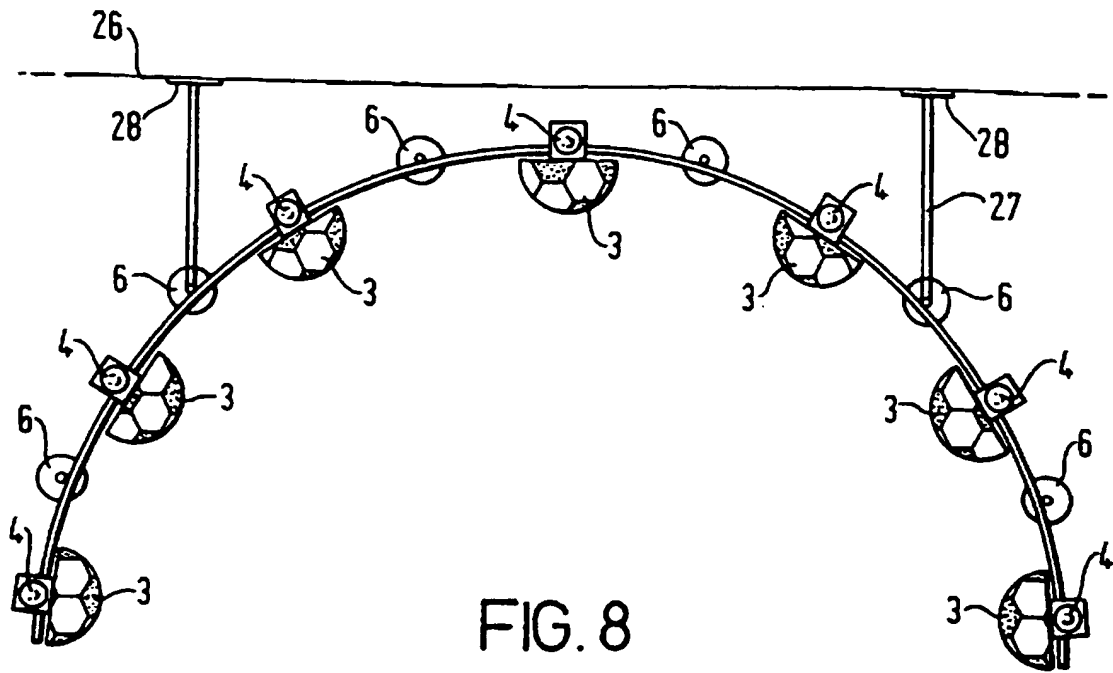


FIG. 8

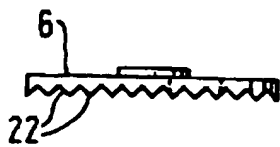


FIG. 9

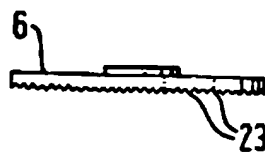


FIG. 9A

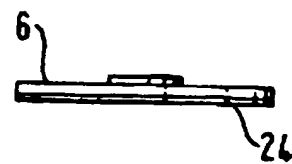


FIG. 9B

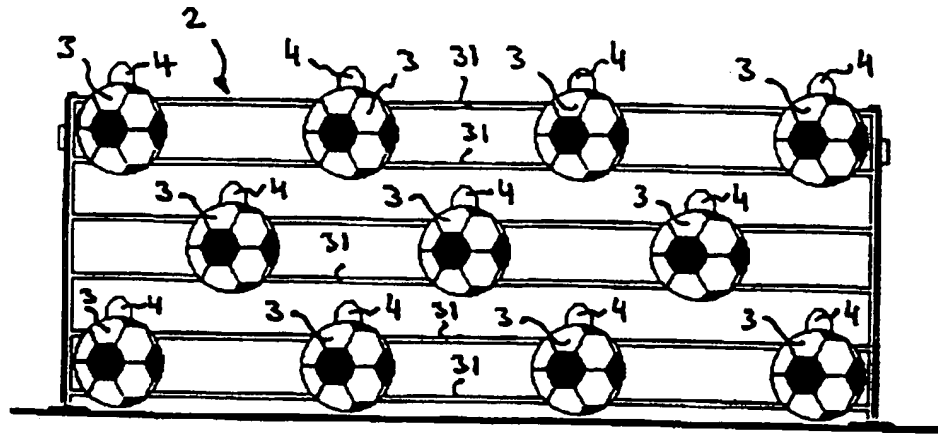


FIGURE 10.

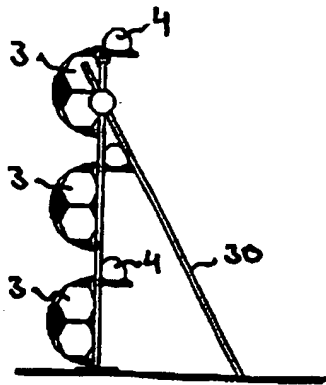


FIGURE 10A.

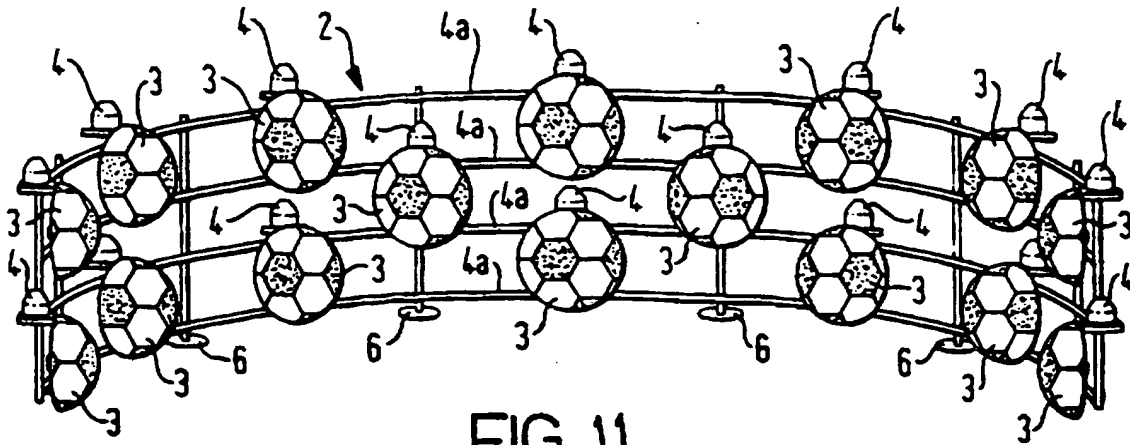


FIG. 11

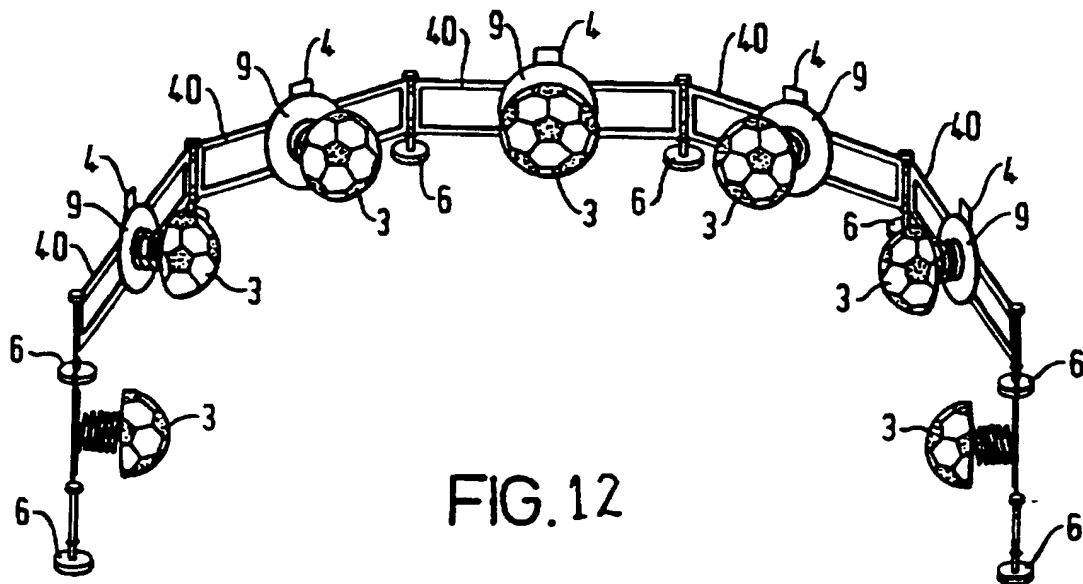


FIG. 12

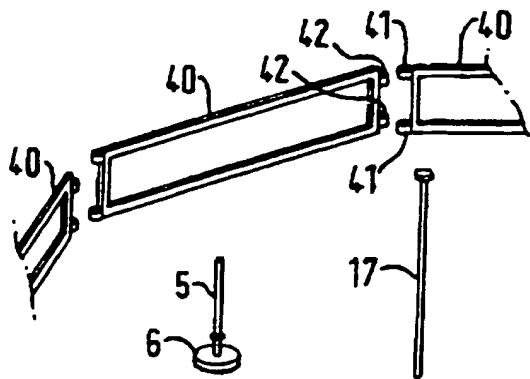


FIG. 13

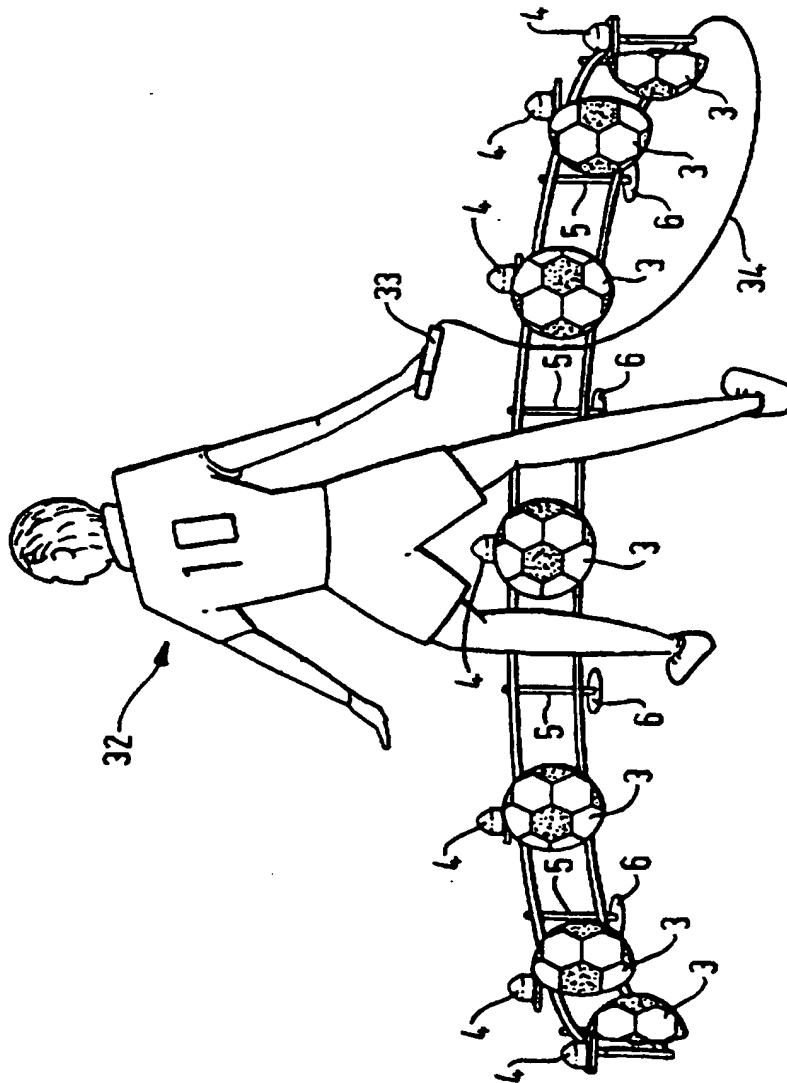


FIG. 14

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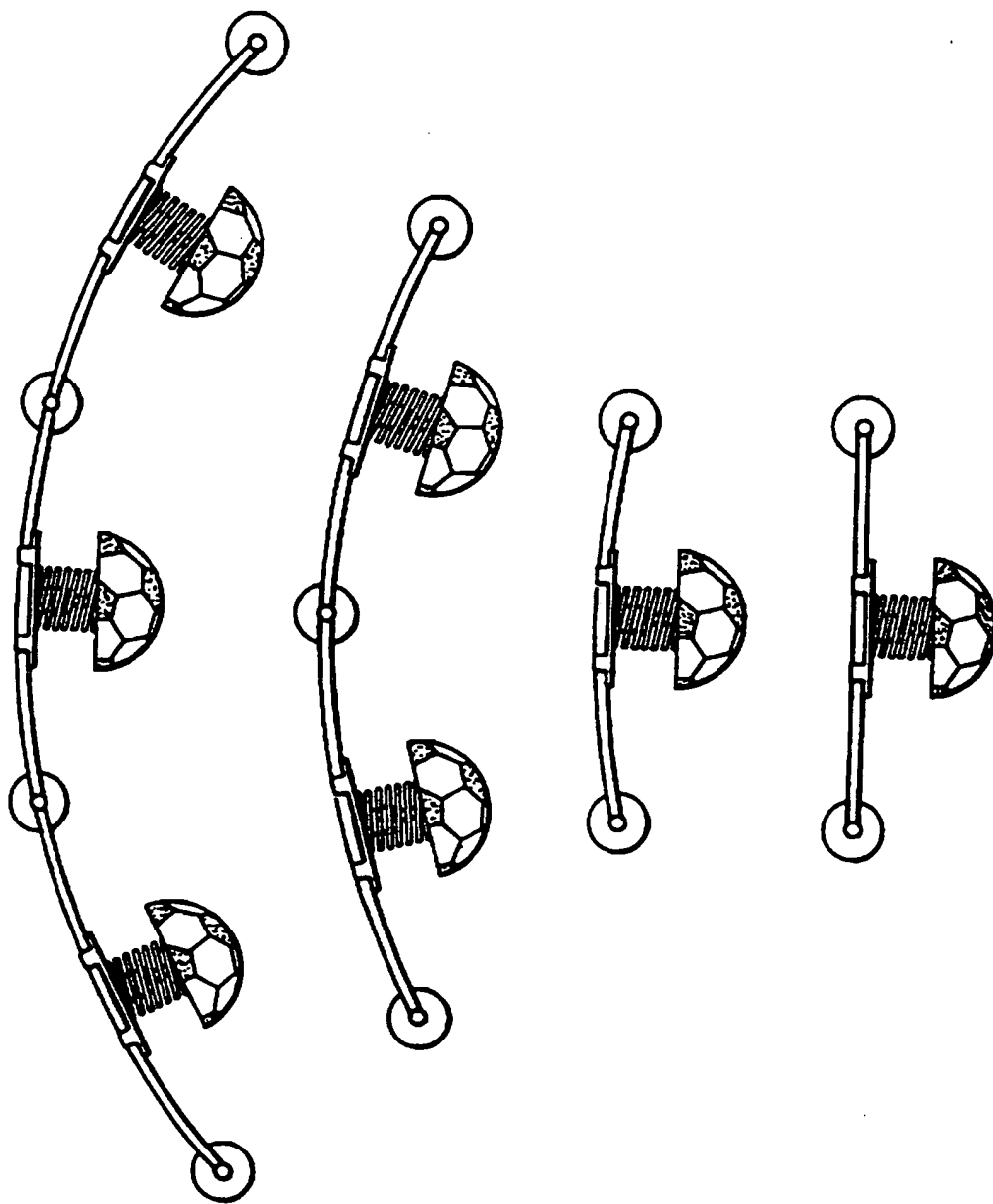


FIG. 15

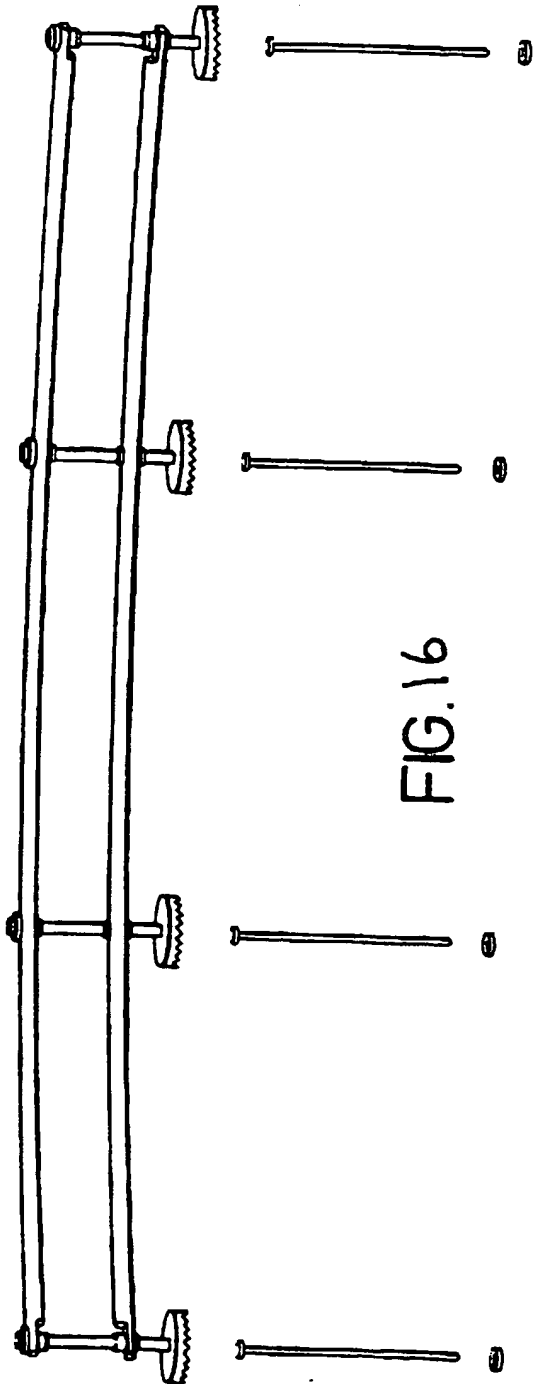


FIG. 16

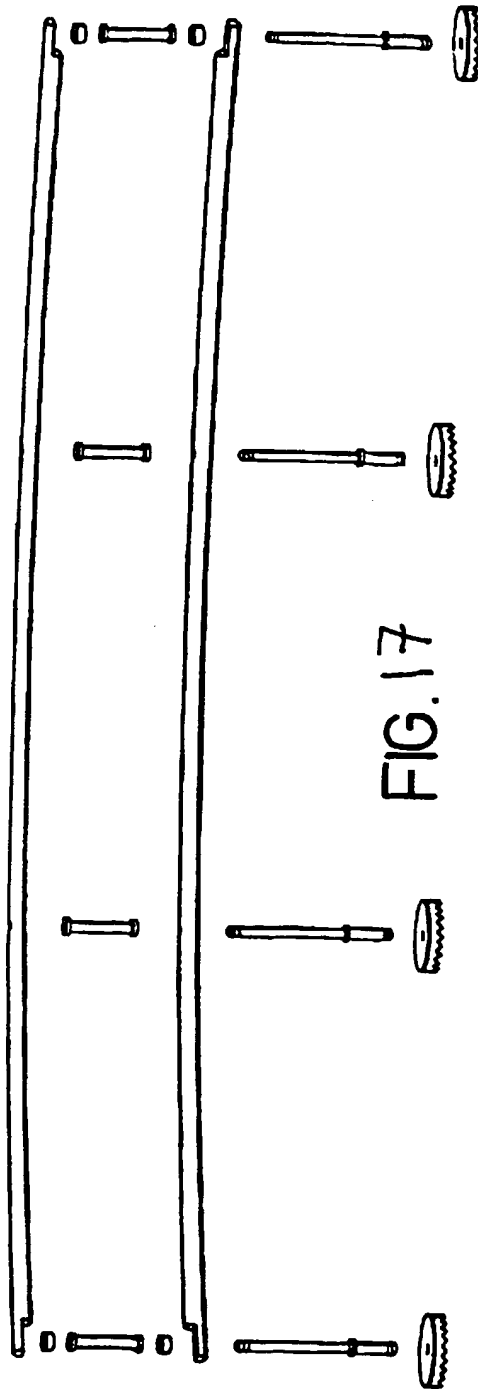


FIG. 17

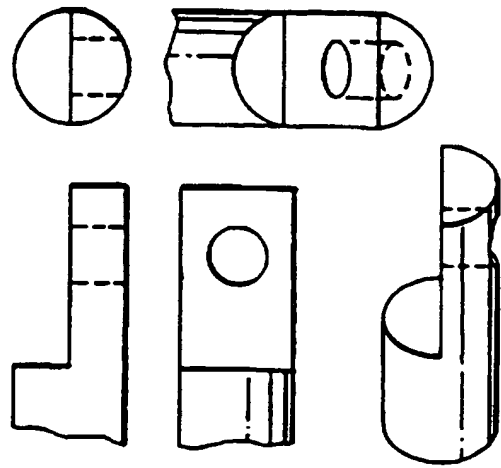


FIG. 20

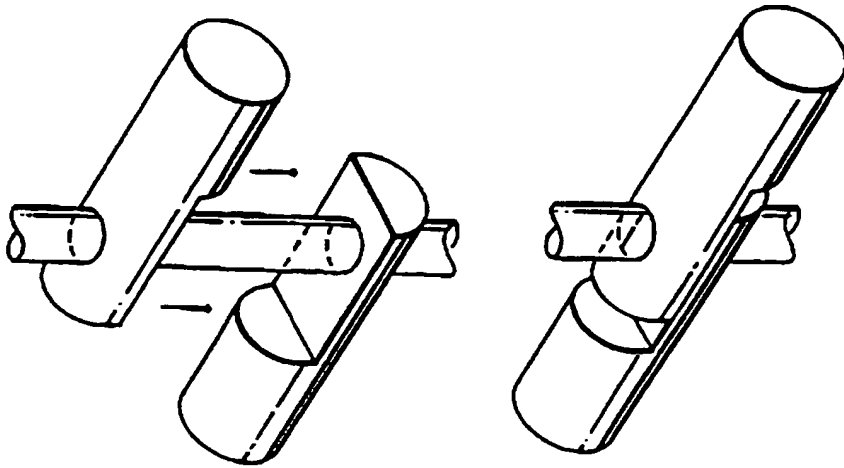


FIG. 19

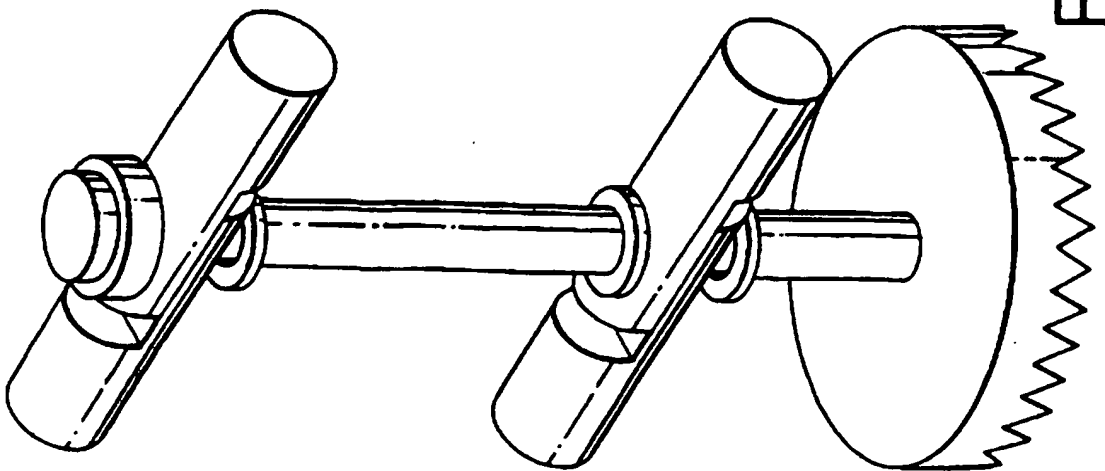


FIG. 18

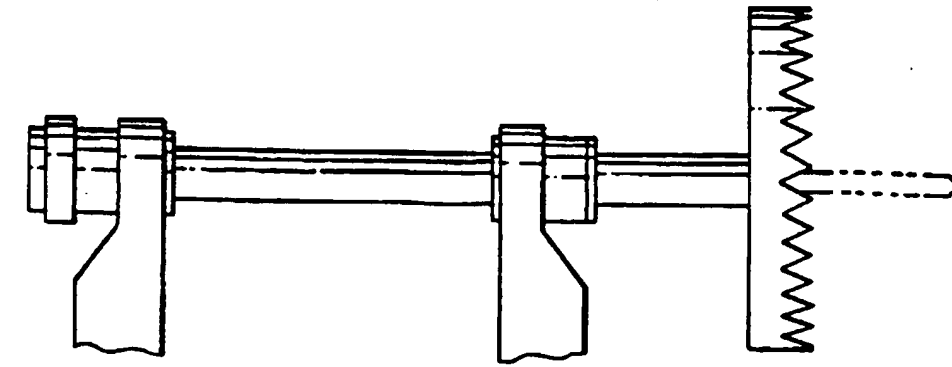


FIG. 23

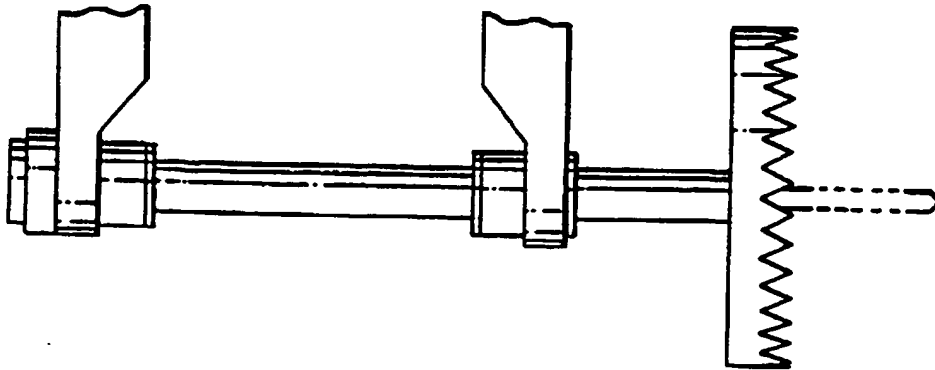


FIG. 22

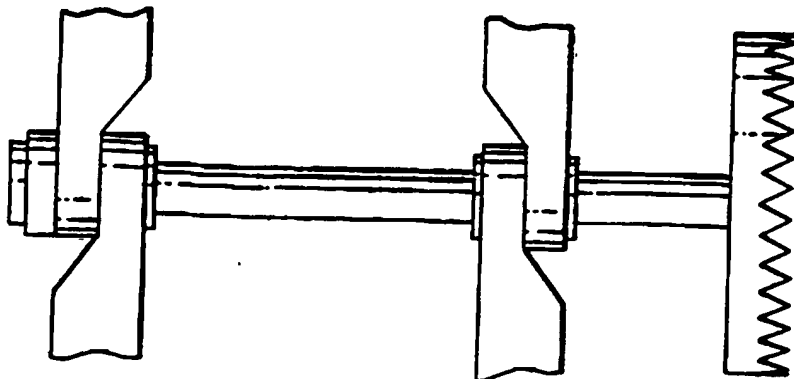


FIG. 21

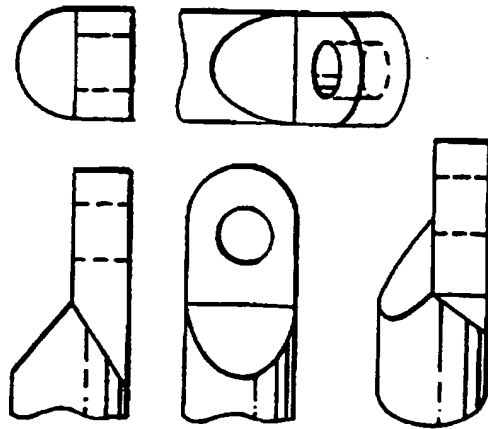


FIG. 26

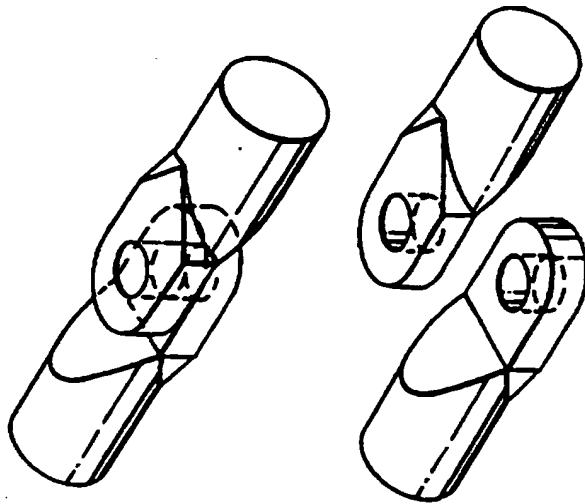


FIG. 25

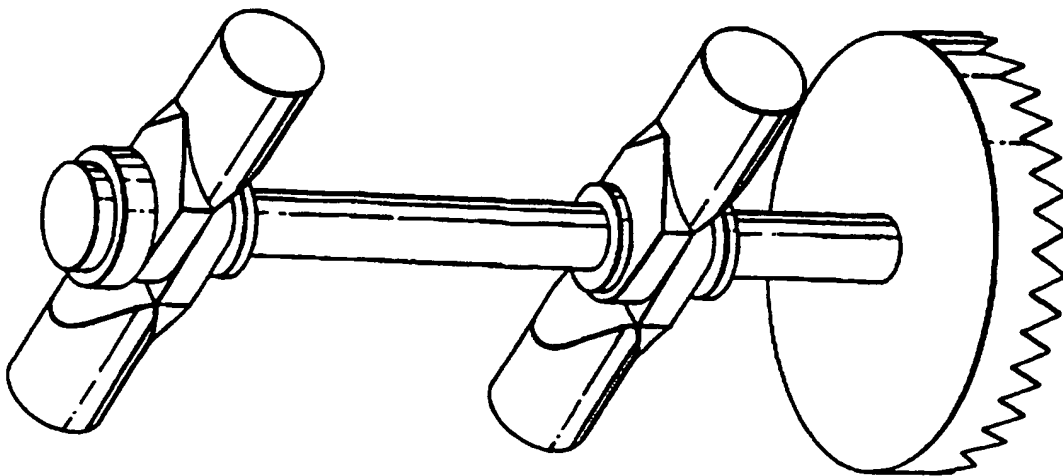


FIG. 24